A Poison-Secreting Nudibranch (Mollusca : Opisthobranchia)

BY

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Thompson (1960) has reviewed defense mechanisms in opisthobranchs. He pointed out that while some secrete an acid when disturbed and others possess cnidosacs, many species possess neither weapon yet are seldom eaten by fish. The present report concerns a possible third defense mechanism. Tests with the nudibranch, Phyllidia varicosa Lamarck, 1801 (syn. P. trilineata Cuvier, 1804), indicate that when disturbed it secretes a profuse mucus containing a poison.

METHODS AND OBSERVATIONS

This study arose from the observation that a slipper lobster, Scyllarides squammosus (H. M. Edwards, 1837), and a homarid lobster, Enoplometopus occidentalis (Randall, 1839), died within an hour after a specimen of Phyllidia varicosa, dripping a light-grey mucus, was introduced into a 15-gallon aquarium with them. The work was performed using the mucus from four mature specimens of this nudibranch 9, 10, 12, and 13 cm. long. The mucus was collected in a beaker by gently squeezing the nudibranchs, an action which stimulated the flow of about five ml. of the mucus within a few seconds.

Three other species of crustaceans, Periclimenes spec., Lembos intermedius Schellenberg, 1938, and Tisbe reticulata Bocquet, 1951, and a poecilid fish, Mollinesia latipinna Le Sueur, 1821, invariably died within one-half to five hours after being placed in seawater containing approximately 2 percent of the mucus.

Lack of any response to being prodded with a dissecting needle was used as the criterion of death for all species. No animal ever recovered after being returned to fresh seawater at this stage.

Three or more individuals of each of the above species were also held under the same conditions minus the mucus. There were no deaths among these controls.

Table 1

Effect of Mucus of *Phyllidia varicosa* Lamarck, 1801 on Various Animals

Species	Approximate body length (mm)	Number tested	Number of controls	Death of all animals within ½ to 5 hours	No apparent effect after 24 hours
Lembos intermedius (amphipod)	3	numerous	numerous	+	
Tisbe reticulata (copepod)	1	numerous	numerous	+	
Periclimenes spec. (decapod)	30	numerous	numerous	+	
Mollinesia latipinna (teleost)	35	3	3	+	
Scyllarides squammosus (decapod)	150	2	0	+	
Enoplometopus occidentalis (decapod)	110	1	0	+	
Placobranchus ianthobapsus (nudibranch)	35	1	0		+
Metapograpsus messor (decapod)	25	1	0		+

Single specimens of a crab, Metapograpsus messor (Forskal, 1775) and a nudibranch, Placobranchus ianthobapsus Gould, 1852, showed no apparent ill effects after 48 hours' exposure to twice the concentration of mucus used on the other species.

The distress symptoms in the various susceptible species were varied and prevent much generalization. In mice and the walking crustaceans loss of control of the legs was one of the first symptoms noted.

A test with pHydrion pH paper showed the pH of the secretion to be approximately 7. The mucus had a strong, unusual smell. The descriptions of the smell given to the writer by several individuals were so varied and sometimes contradictory that no further description is attempted. The secretion had no apparent taste.

Groups of Periclimenes spec. and Lembos intermedius were used as bio-indicators in investigating the stability of the poison. Several of one or the other of these species were placed in 2 percent mucus-seawater which had been exposed to one of the treatments described below in order to determine if the poison had been inactivated. Either all the animals were dead within five hours or none died within ten hours. In the latter case the poison was considered inactivated. Control flasks were run in all cases.

In tightly stoppered flasks at room temperature the seawater-mucus mixture remained toxic for at least six days. However, the mixture lost its toxicity in less than three days in open flasks, suggesting that the poison is volatile. Subsequent tests supported this hypothesis. Mucus-containing seawater lost its toxicity within ten minutes when nitrogen, helium, or air was bubbled through it vigorously from an airstone.

In seawater the poison was not inactivated by exposure to temperatures as high as 95° C. for approximately one minute. The poison could be filtered out of seawater using an HA Millipore filter (0.45 μ pore diameter). The poison appeared to be trapped in rather than on the filter. Whole filters used to filter the mixture, then placed in flasks of seawater containing test animals, were not toxic. If the filters were finely shredded before they were introduced, they proved toxic.

Discussion

When disturbed, Phyllidia varicosa secretes in its mucus a substance which is toxic to a variety of animals. Apart from the problem of the chemical nature of this poison, an interesting question arises from this observation: is the poison of P. varicosa an isolated phenomenon among opisthobranchs or a third general defense mechanism? Certainly, some presently unexplained factor is operative in protecting the many soft-bodied opisthobranchs possessing neither cnidosacs nor acid secretions from predation.

Risbec (1928) states that a voluminous, strong-smelling mucus emitted by the animal when disturbed is characteristic of most Phyllidiads. If this strong smell is associated with the poison as it appears to be (whenever the poison was inactivated the smell disappeared), it would indicate that the poison is not restricted to Phyllidia varicosa but prevalent within the family Phyllidiadae.

With regard to opisthobranchs in general, Thompson (1960) points out the widespread occurrence of skin glands (apart from mucus and acid glands) "whose position and function can only be explained satisfactorily as defensive." The possibility that these glands secrete poisons and that poison secretion is not an unusual means of defense among opisthobranchs might be examined.

Literature Cited

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